

QUICKLOAD PROGRAM TECHNICAL DATA PACKAGE

Use of the Sand Grid Wall to Prevent
Propagation Between Truckloads of
155mm Artillery Ammunition

Developed by
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For
Project Manager Ammunition Logistics
Picatinny Arsenal, NJ

2 December 1991

1. EXECUTIVE SUMMARY

A. Description:

The wall is made of sand and stabilized with an expandable plastic grid material.

B. Use:

The wall is used in theaters of operations to separate trucks or trailers uploaded with 155mm artillery ammunition.

C. Benefits:

The wall prevents simultaneous detonation between uploaded trucks or trailers. The separation distance between trucks or trailers is reduced to only 15 feet. Chapter 10 of Army Regulation 385-64 normally requires 163 feet separation if unbarricaded or 27 feet separation if barricaded. For a given area, this greatly increases the number of uploaded trucks which can be safely stored. At 163 feet separation, the storage density is 1.3 trucks per acre. At 27 feet separation, the storage density is 21.8 trucks per acre. With the sand grid wall's 15 foot separation, the storage density is increased to 42.1 trucks per acre.

D. Building Information:

The wall can be quickly built using troop labor. The addition of a front end loader will facilitate construction.

E. Lifetime:

The wall is estimated to last 20 years. The wall should be inspected periodically to insure no loss in sand content.

F: Rough Cost:

The 20 foot long wall described in this TDP will cost approximately \$800 in sand grid material.

G. Drawbacks:

The wall is not approved for use with all munitions, only approved 155mm artillery projectiles and associated propellant charges. The wall is also not approved for use with fuzes.

2. BACKGROUND

An inspection tour of the U.S. bases in the Republic of Korea by the Department of Defense Explosives Safety Board (DDESB) members revealed that, in many cases, ammunition was stored close to occupied areas. Limited available space precluded simply moving ammunition away from potential civilian targets. For operational reasons, artillery ammunition was stored uploaded on closely parked trucks and trailers. The possibility existed that a detonation of one round on one truck could cause a chain reaction of explosions from truck to truck resulting in a catastrophic explosive event. A method was needed to contain the reaction to a single truck to reduce the overall violence and achieve a smaller quantity distance for the storage site.

3. ITEM DESCRIPTION

The sand grid wall material is typically made from high density polyethylene (HDP) plastic strips approximately 8 inches wide. The strips are welded together at 13 inch intervals to form honeycomb grid sections. The HDP plastic is treated with ultraviolet stabilizers to prevent breakdown of the grid material when exposed to field conditions. The grid material is easily collapsible for storage and shipping.

The sand grid wall is constructed by opening up a section of the welded strips. Stakes are driven in the corners to hold the sand grid open while it is being filled with sand. During construction, plastic sheeting is placed between successive eight inch sand grid layers to prevent excessive leakage and settling of the sand. Any available plastic sheeting may be used however 6mm thick black plastic polyethylene sheeting is preferable. Layers are continually added until the desired height is achieved. For the barrier wall between two trucks, a triangular shaped wall 8 feet tall is built. It is 76.8 inches wide at the base and every other grid section is cut to make a smaller width. The final width at the top of the wall is 19.2 inches. Photographs of the sand grid wall being used between two trailers is shown in figures 1 and 2. A photograph of the sand grid wall during validation testing is shown in figure 3.

4. USE OF THE ITEM

The sand grid wall may be used as a barricade in storage areas to separate truck or trailer loads of 155mm artillery projectiles plus associated propellant charges. Limitations are as follows:

A. Use is limited to theaters of operations.

B. No more than 160 projectiles, plus associated propelling charges, may be on any truck or trailer.

C. The minimum separation between trucks or trailers so loaded is 15 feet.

D. Use is limited to the following projectiles: M107, M110, M110E1, M110A1, M110A2, M110E2, M110E3, M116, M116A1, M116B1, M118, M449, M483A1, M485, M485A1, M485A2, M549, M549A1, XM631, M692, M718 M731, M741, M825, M825A1. A table of these projectiles including DODICS is contained in figure 4.

E. Inhabited building and public traffic route distances are 1800 and 1080 feet respectively except as authorized by Chapter 10 of DoD 6055.9-STD. If chapter 10 is authorized, then the inhabited building and public traffic route distances are 886 and 591 feet respectively.

5. BENEFITS

A. The wall prevents simultaneous detonation between uploaded trucks or trailers. The separation distance between uploaded trucks or trailers is reduced to only 15 feet. Chapter 10 of Army Regulation 385-64 normally requires 163 feet separation if unbarricaded or 27 feet separation if barricaded. For a given area, this greatly increases the number of uploaded trucks which can be safely stored. At 163 feet separation, the storage density is 1.3 trucks per acre. At 27 feet separation, the storage density is 21.8 trucks per acre. With the sand grid wall's 15 foot separation, the storage density is increased to 42.1 trucks per acre.

B. Sand grid construction offers significant savings in cost, logistical volume, and construction time when compared to sandbag construction. The following data was obtained from testing conducted by the Field Artillery Board in June 1982.

1) Sandbag revetment materials cost 28 percent more than sand grid revetment materials.

2) Sandbag revetment materials weight 15 percent less but occupy 50 percent more volume than sand grid revetment material.

3) Given only troop labor, sandbag revetments require 2 to 3 times longer to construct than sand grid revetments.

4) Given troop labor and a front-end loader, sandbag revetments require nearly 12 times longer to construct than sand grid revetments.

6. LIFE EXPECTANCY

Based on expert opinion, the barrier can be expected to last at least 20 years in the harshest environments (desert, with high ultraviolet exposure).

7. SITE PLANS SUBMISSION

A site plan must be submitted in accordance with AR 385-60 and AR 385-64 to the Department of Defense Explosives Safety Board and approval must be obtained prior to the start of construction.

8. CONSTRUCTION INFORMATION

A. CONSTRUCTION TECHNIQUES:

The first step is site preparation and layout. When possible, the construction site should be chosen to provide a firm, level foundation for the sand grid material. This greatly increases wall stability.

The standard 8 foot by 20 foot sand grid sections must be cut to the proper dimensions shown in figures 5 through 12.

After site preparation, the first layer of sand grid material is stretched to its proper length. Army issue U-pickets or #3 or #4 reinforcing rods are used in each of the four corners of the grid to secure it during filling. A front end loader or shovels can be used to fill the grid sections with fill material. One inch of overfill is advised to allow for compaction.

After one layer of grid has been filled and compacted, it should be leveled in preparation for the next layer. Placement of a sheet of plastic between successive layers of the revetment provides support for the next grid section and helps to prevent excessive sand leakage. After the plastic sheeting is placed over the first layer of grid materials, the second layer is stretched to its proper length and filled. This process is repeated until the revetment reaches the desired height. The steps necessary for proper construction of a standard sand grid revetment are shown in figure 13. Time/Cost estimation sheets and additional sand grid wall construction information is contained in figures 14 through 17.

B. BILL OF MATERIALS

BILL OF MATERIALS FOR ONE WALL

<u>ITEM</u>	<u>QUANTITY</u>
Sand grid, 8 ft by 20 ft section NSN: 5680-01-198-7955	<u>7 sections</u>
Sheeting, Black Polyethylene, 6 mil thick Note: Although 6mm black polyethylene sheeting is preferred, any available plastic sheeting may be used.	<u>105 sq yds min</u>
Sand, containing stones no greater than 1/2 in dia, comprising less than 10% total volume. Note: This quantity allows for compaction of a one inch overfill for each grid section.	<u>29.25 yds</u>

C. PROCUREMENT/REQUISITION INFORMATION

For rough estimation purposes, requisition costs have ranged from \$110 to \$200 per each 8 ft by 20 ft section. Funded requisitions can be submitted to U.S. Army Troop Support Command (TROSCOM) (A12 account). If requisitioning cannot deliver the material, installations may order sand grids direct from the manufacturer. Two manufacturers produce an acceptable product:

Presto Products, Inc
P.O. Box 2399
Appleton, WI 54913

AGH Industries, Inc.
7420 White Hall
Dallas, TX 76118-6426

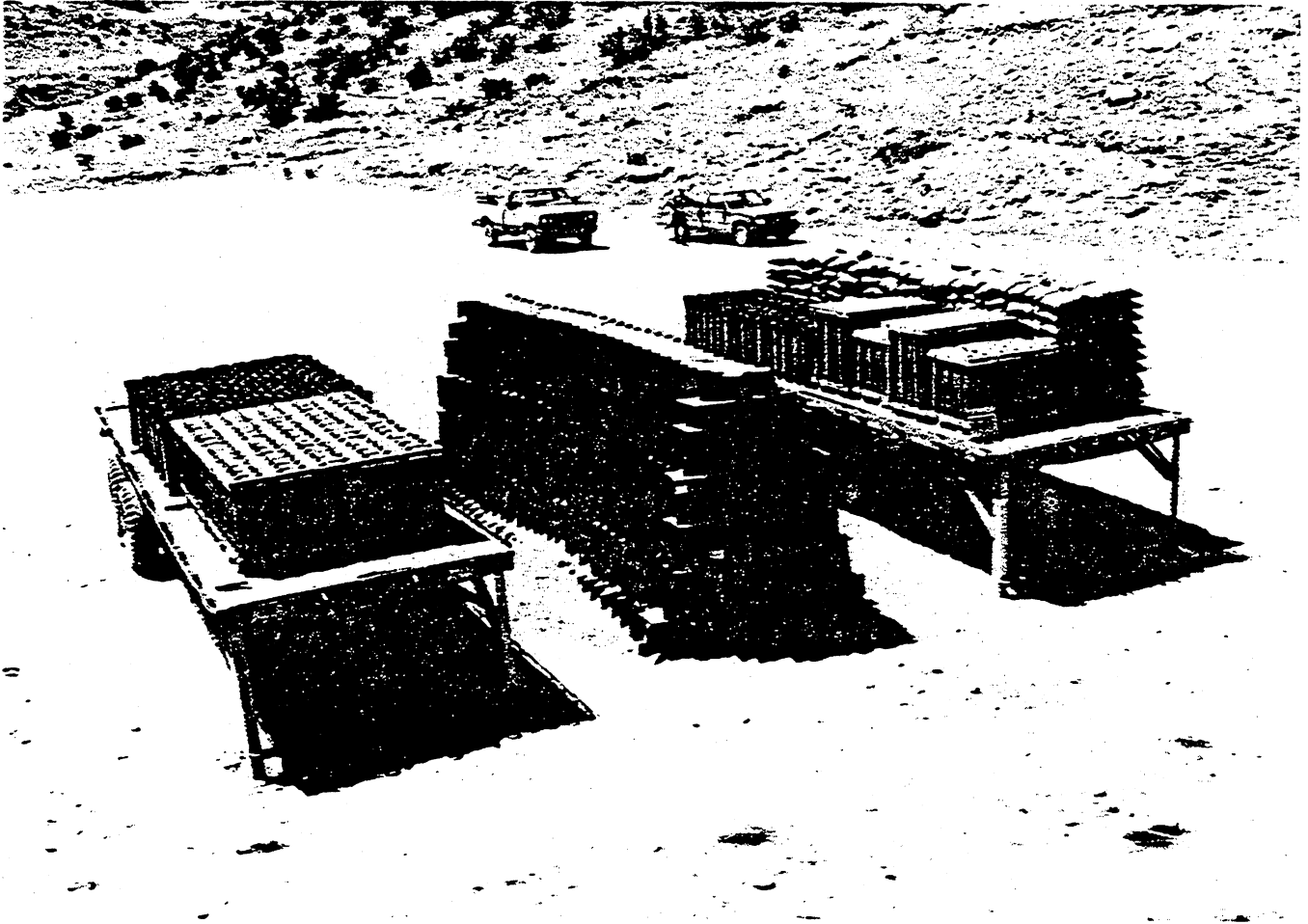
10. ACKNOWLEDGEMENTS

This work was sponsored by the Project Manager for Ammunition Logistics. Testing was performed at Socorro, New Mexico by the TERA Group of the New Mexico Institute of Mining and Technology. The sand grid material was originally developed by the Geotechnical Laboratory at the Waterways Experiments Station in Vicksburg, Mississippi for use in roadway construction over loose soils and sand.

11. ADDITIONAL INFORMATION

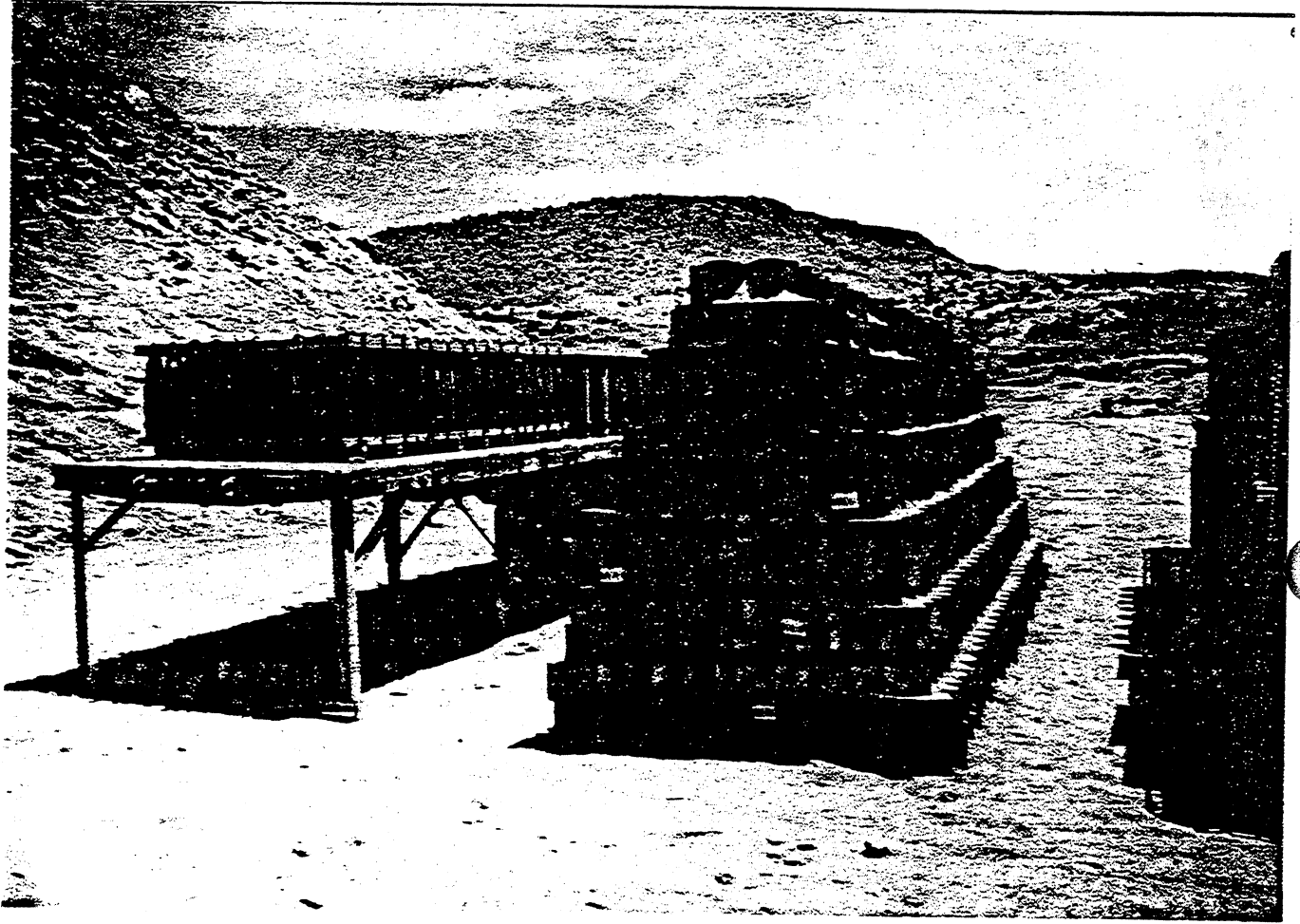
Any questions or comments related to this Technical Data Package or the Quickload Program should be directed to:

Project Manager, Ammunition Logistics
ATTN: AMCPM-AL, Robert Rossi
Picatinny Arsenal, NJ 07806-5000
DSN 880-2188 or (201) 724-2188



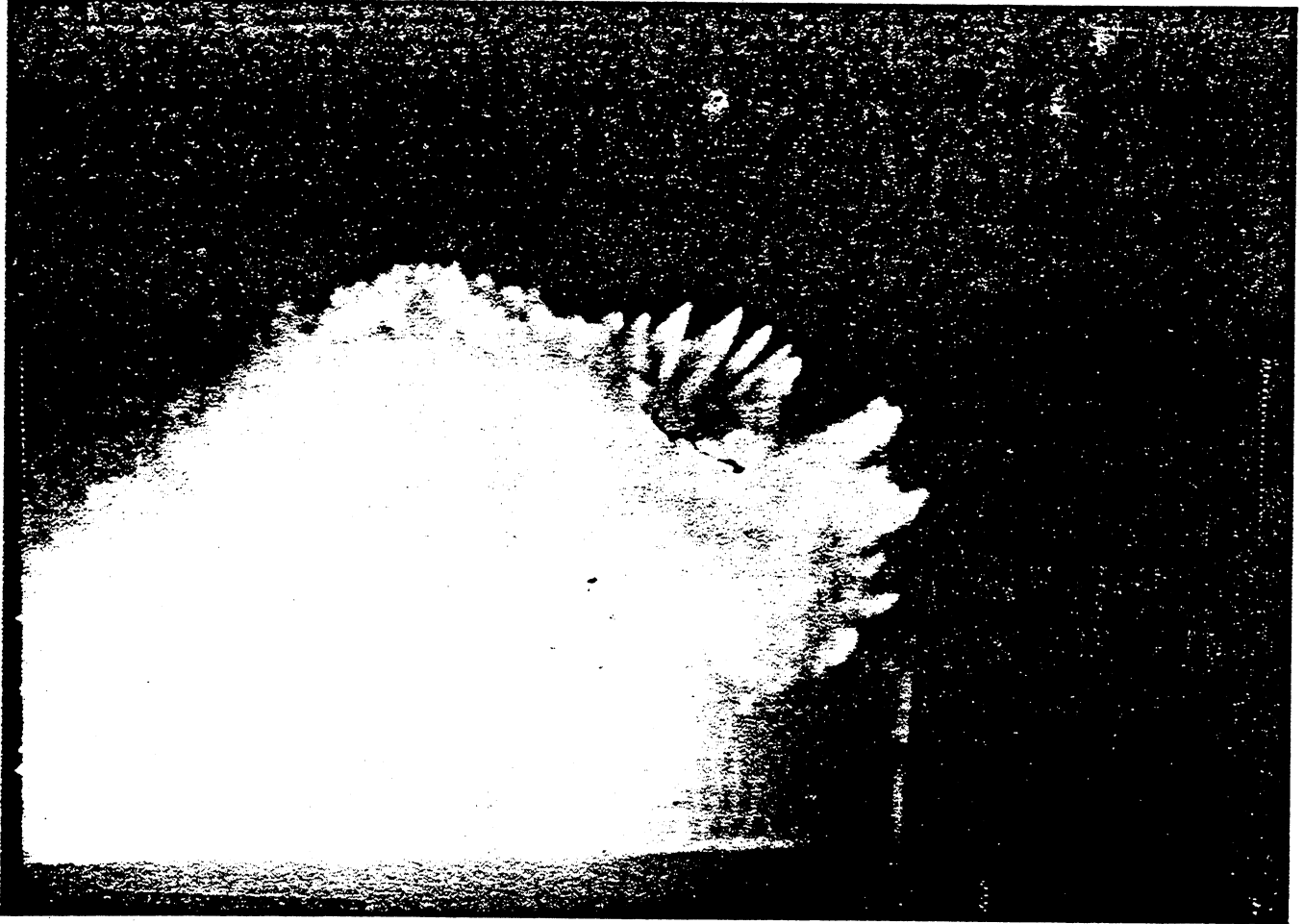
The Sand Grid Wall Between Two Uploaded Trailers

Figure 1



The Sand Grid Wall Between Two Uploaded Trailers

Figure 2



The Sand Grid Wall During Validation Testing

Figure 3

155MM ARTILLERY AMMUNITION

APPROVED PROJECTILES

DODIC	NOMENCLATURE
1320-D544	PROJECTILE, 155MM, HE, M107 (COMP B)
1320-D544	PROJECTILE, 155MM, HE, M107 (TNT)
1320-D543	PROJECTILE, 155MM, H OR HD, M110
1320-D550	PROJECTILE, 155MM, SMK WP, M105/M110 SERIES
1320-D547	PROJECTILE, 155MM, SMK GRN, M116
1320-D548	PROJECTILE, 155MM, SMK HC, M116
1320-D549	PROJECTILE, 155MM, SMK RED, M116
1320-D551	PROJECTILE, 155MM, SMK YLW, M116
1320-D554	PROJECTILE, 155MM, SMK VIO, M116
1320-D506	PROJECTILE, 155MM, SMK HC/BE M116A1
1320-D545	PROJECTILE, 155MM, ILLUM, M118
1320-D505	PROJECTILE, 155MM, ILLUM, M485 SERIES
1320-D561	PROJECTILE, 155MM, HE APER, M449/449E1
1320-D562	PROJECTILE, 155MM, HE APER, M449A1
1320-D563	PROJECTILE, 155MM, HE APER M483 SERIES
1320-D579	PROJECTILE, 155MM, HE RAP, M549 SERIES
1320-D501	PROJECTILE, 155MM, HE ADAM, M692E1
1320-D503	PROJECTILE, 155MM, HE RAAM-L, M718
1320-D515	PROJECTILE, 155MM, HE RAAM-L, M718A1
1320-D502	PROJECTILE, 155MM, HE ADAM, M731
1320-D509	PROJECTILE, 155MM, HE RAAM-S, M741
1320-D514	PROJECTILE, 155MM, HE RAAM-S, M741A1
1320-D528	PROJECTILE, 155MM, SMK WP, M825

Figure 4

TITLE:

SAND BARRIER

NOTES:

BASIC SAND BARRIER MADE FROM 7 EACH 8 FT BY 20 FT SECTIONS
ALL DIMENSIONS ARE IN INCHES
ALL WEBBING LAYERS ARE SAND FILLED
MAX. ROCK SIZE IN SAND IS 0.5", < 10% TOTAL VOL.

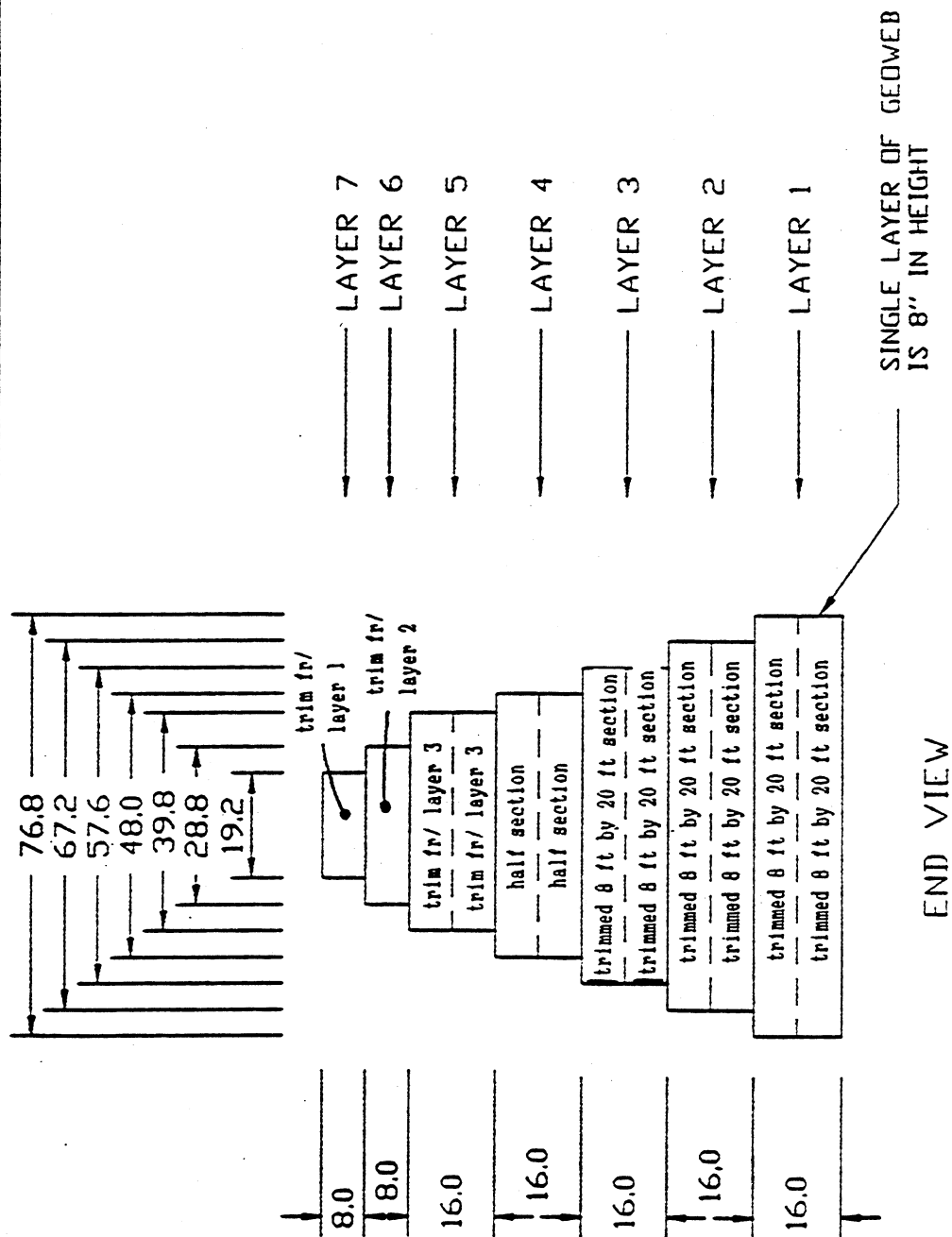


Figure 5

TITLE:

SAND BARRIER

NOTES:

BASIC GEOWEB MATERIAL--LAYER 1
TWO EACH REQUIRED FOR LAYER 1
TOTAL THICKNESS OF LAYER 1 = 16"
ALL DIMENSIONS ARE IN INCHES

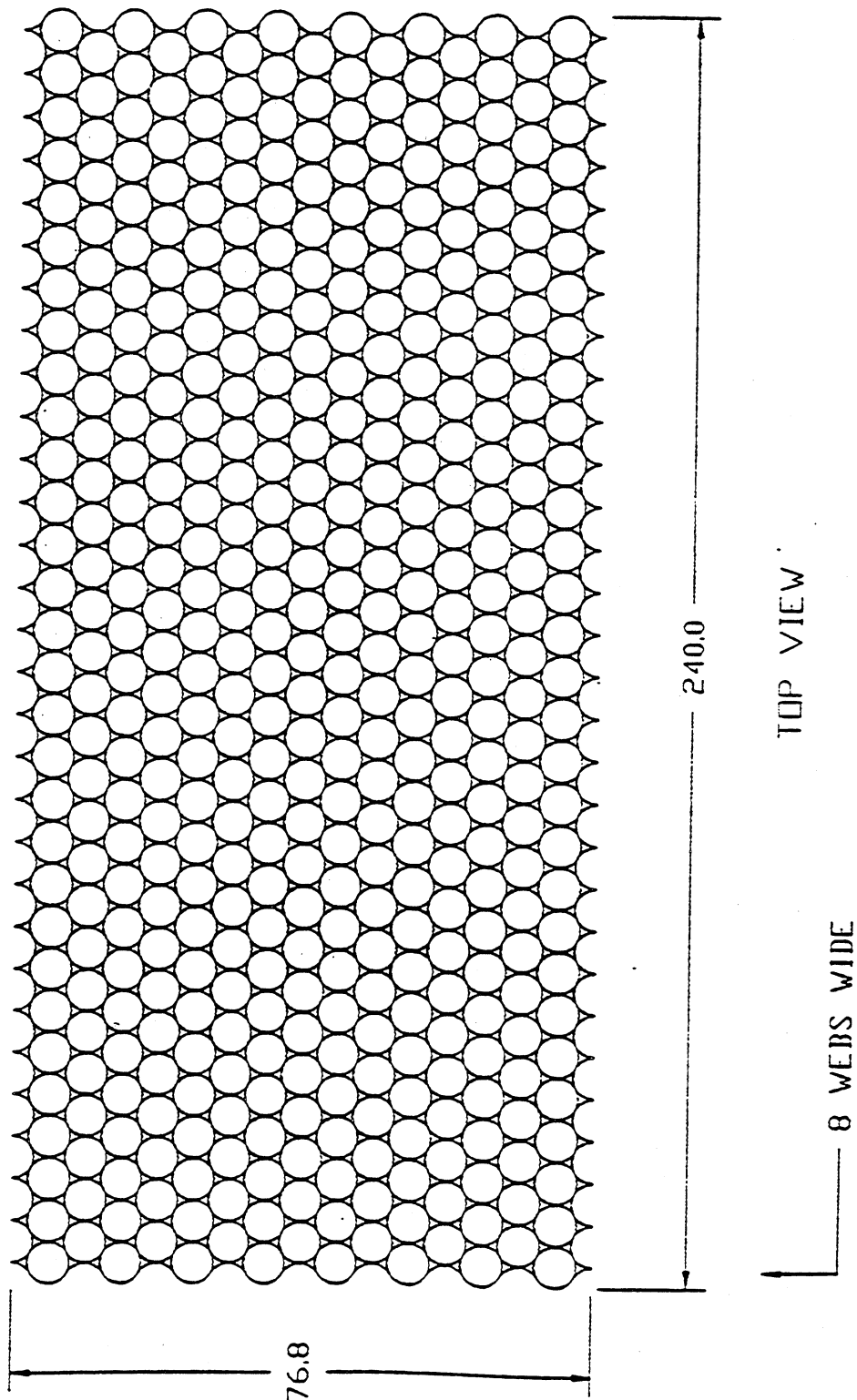


Figure 6

TITLE:

SAND BARRIER

NOTES:

BASIC GEOWEB MATERIAL--LAYER 2
TWO EACH REQUIRED FOR LAYER 2
TOTAL THICKNESS OF LAYER 2 = 16"
ALL DIMENSIONS ARE IN INCHES

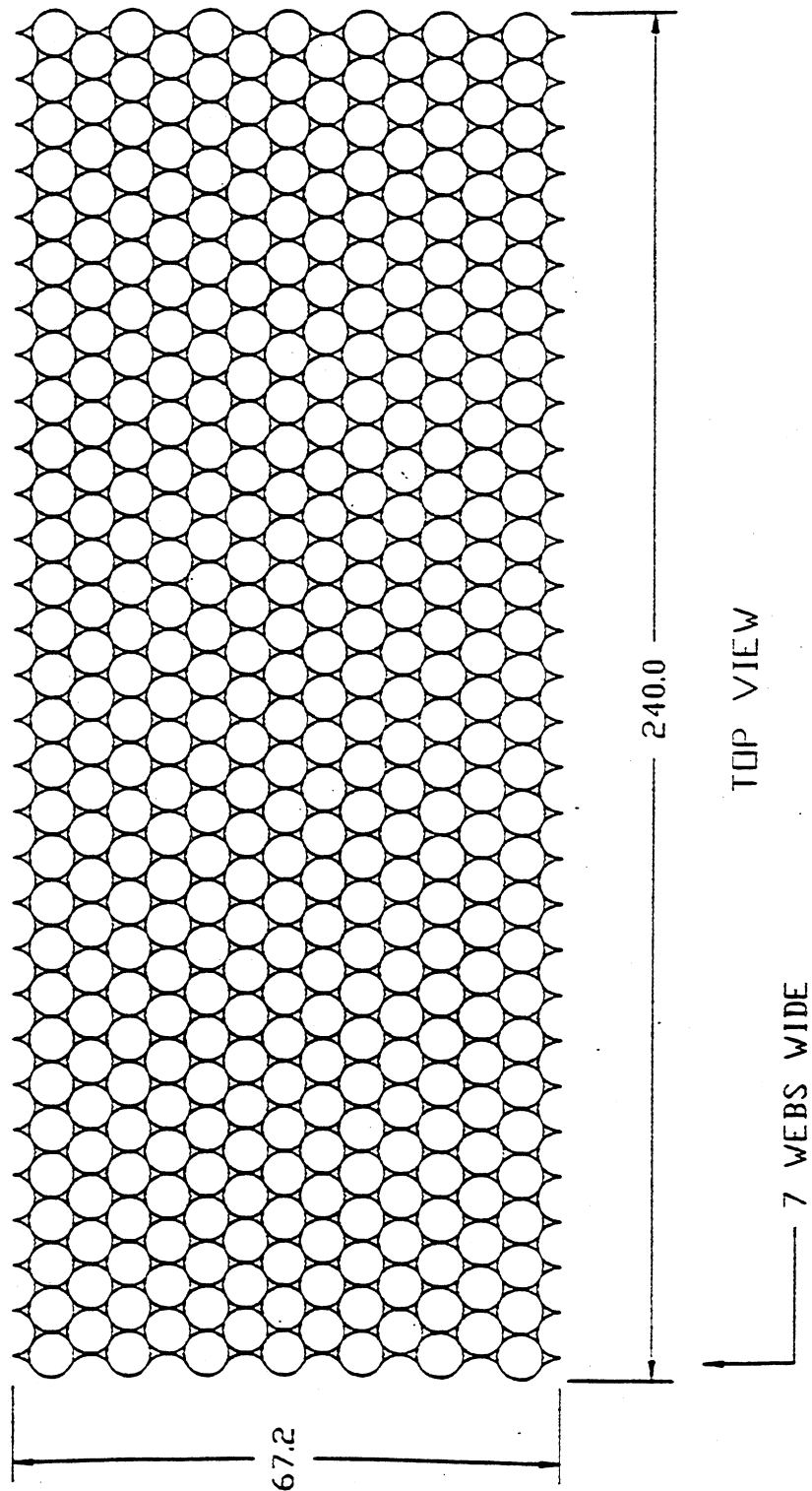


Figure 7

TITLE:

SAND BARRIER

NOTES:

BASIC GEOWEB MATERIAL--LAYER 3
TWO EACH REQUIRED FOR LAYER 3
TOTAL THICKNESS OF LAYER 3 = 16"
ALL DIMENSIONS ARE IN INCHES

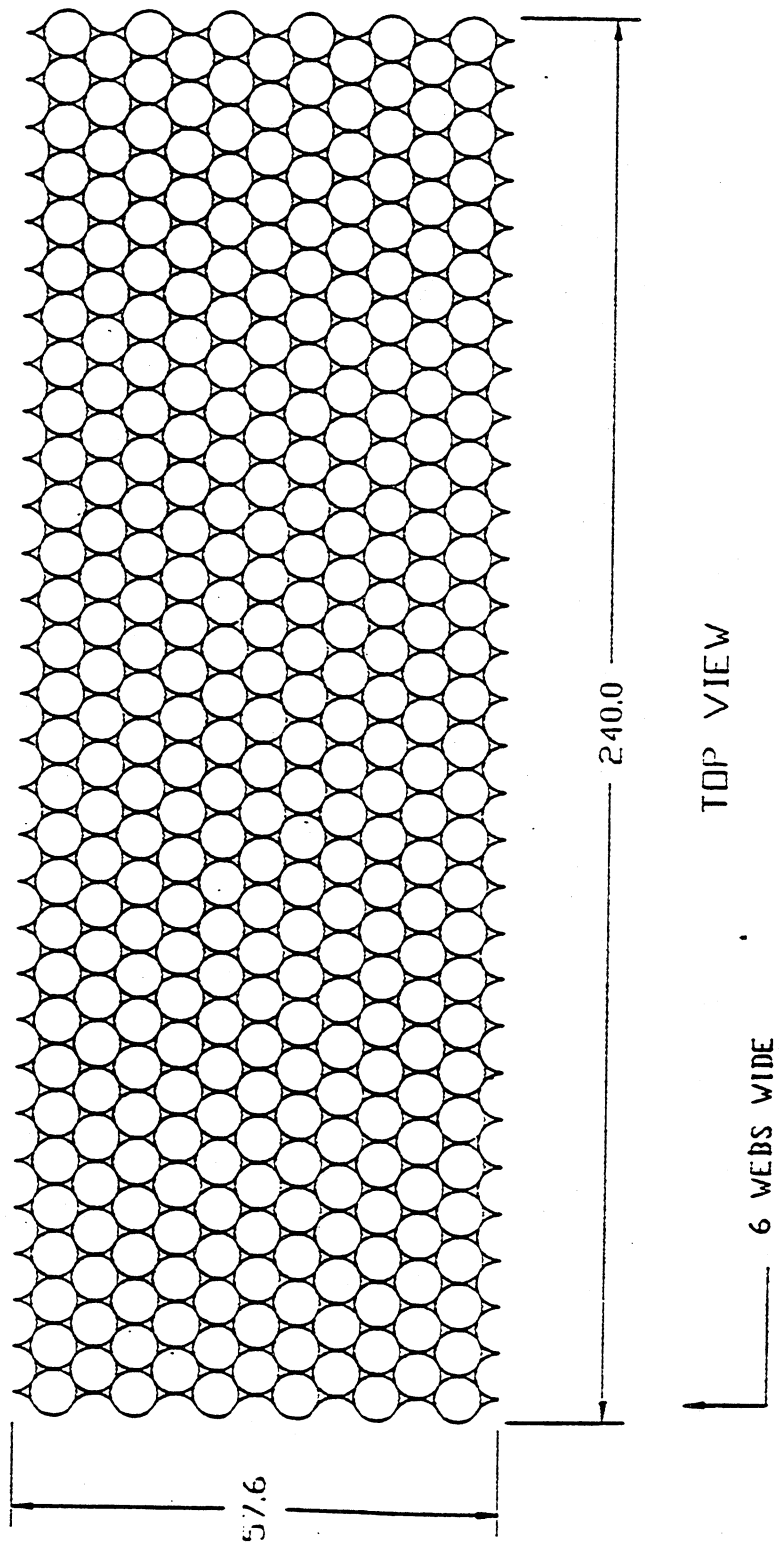


Figure 8

TITLE:

SAND BARRIER

NOTES:

BASIC GEOWEB MATERIAL--LAYER 4
TWO EACH REQUIRED FOR LAYER 4
TOTAL THICKNESS OF LAYER 4 = 16"
ALL DIMENSIONS ARE IN INCHES

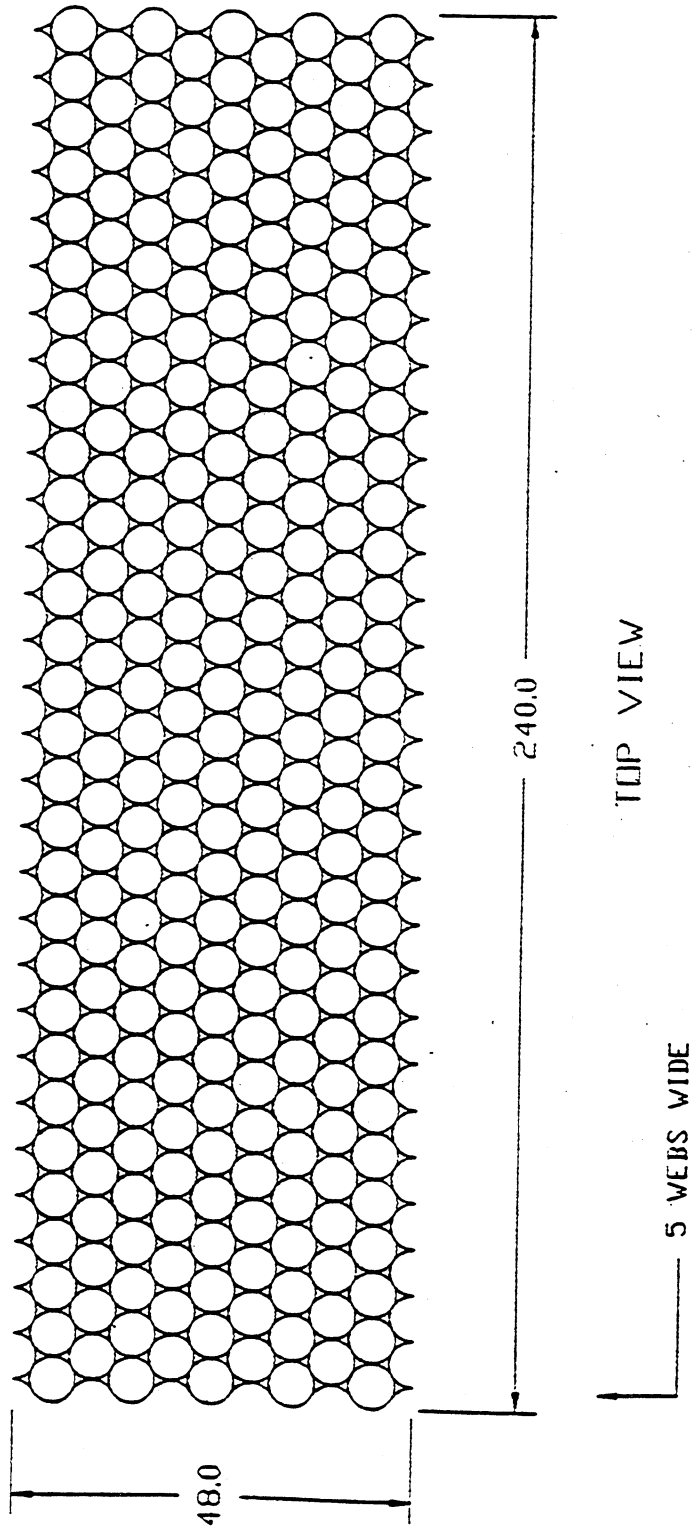


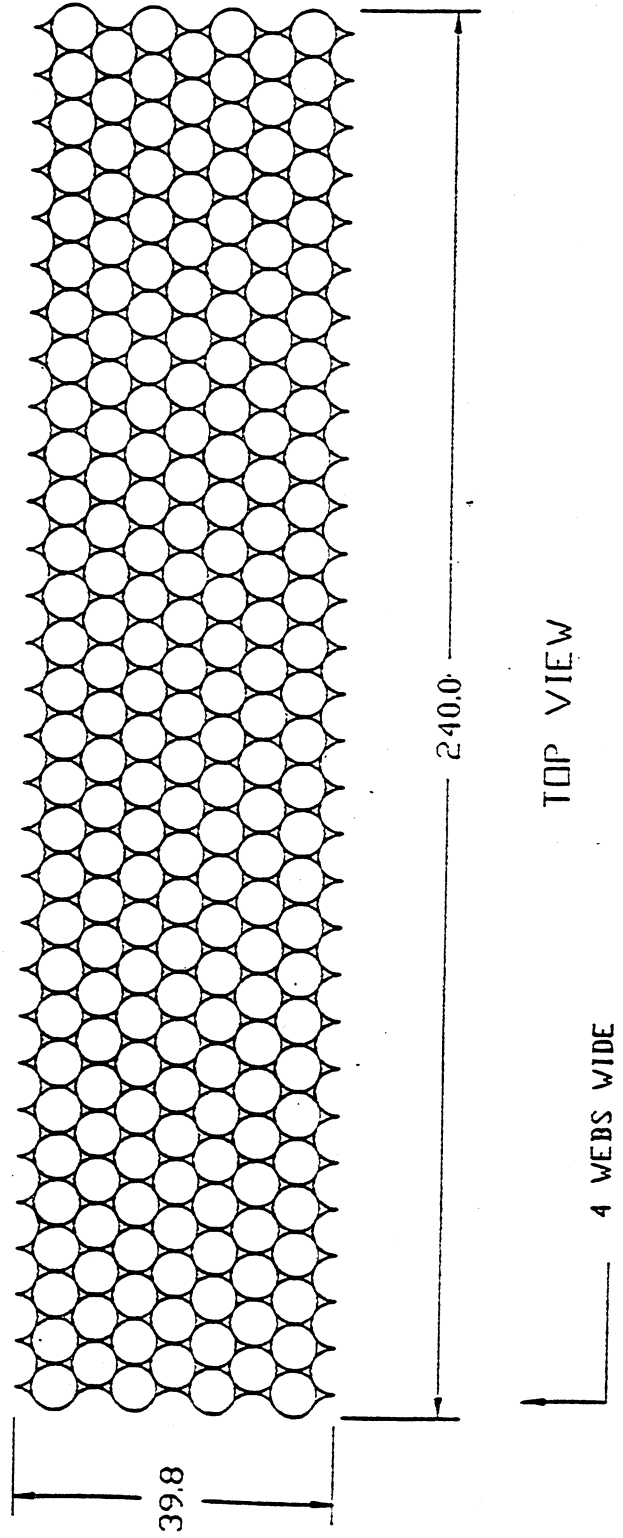
Figure 9

TITLE:

SAND BARRIER

NOTES:

BASIC GEOWEB MATERIAL--LAYER 5
TWO EACH REQUIRED FOR LAYER 5
TOTAL THICKNESS OF LAYER 5 = 16"
ALL DIMENSIONS ARE IN INCHES



TITLE:

SAND BARRIER

NOTES:

BASIC GEOWEB MATERIAL -- LAYER 6
ONE EACH REQUIRED FOR LAYER 6
TOTAL THICKNESS OF LAYER 6 = 8"
ALL DIMENSIONS ARE IN INCHES

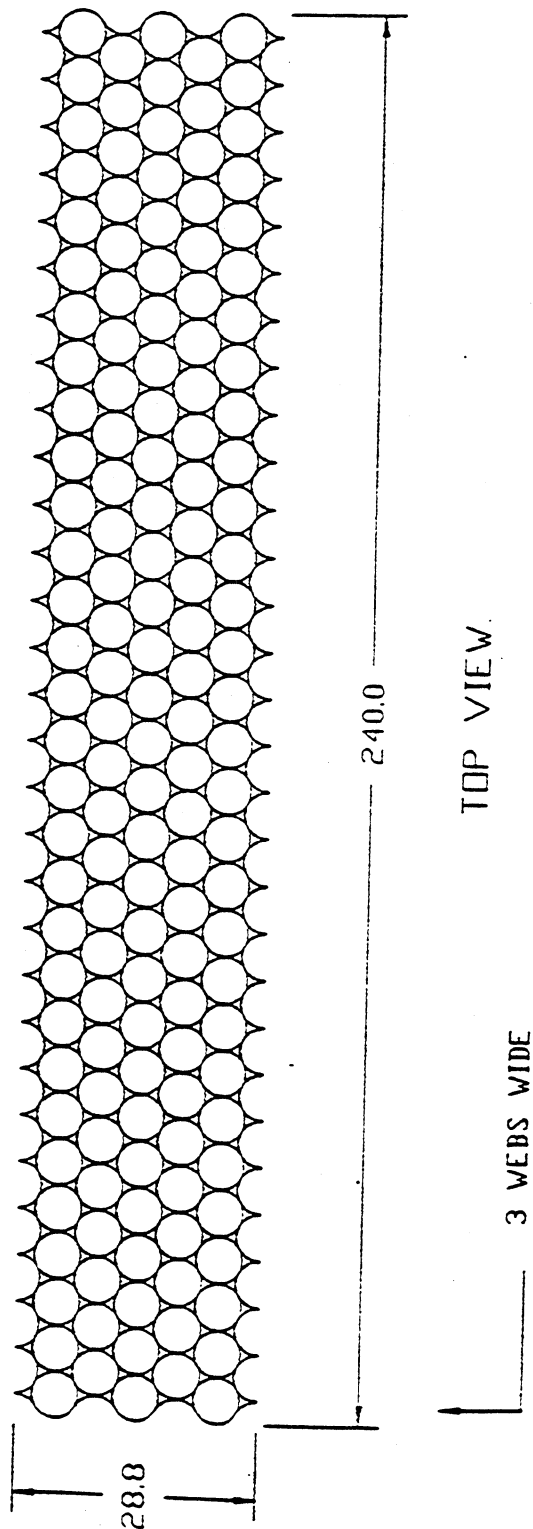


Figure 11

TITLE:

SAND BARRIER

NOTES:

BASIC GEOWEB MATERIAL--LAYER 7
ONE EACH REQUIRED FOR LAYER 7
TOTAL THICKNESS OF LAYER 7 = 8"
ALL DIMENSIONS ARE IN INCHES

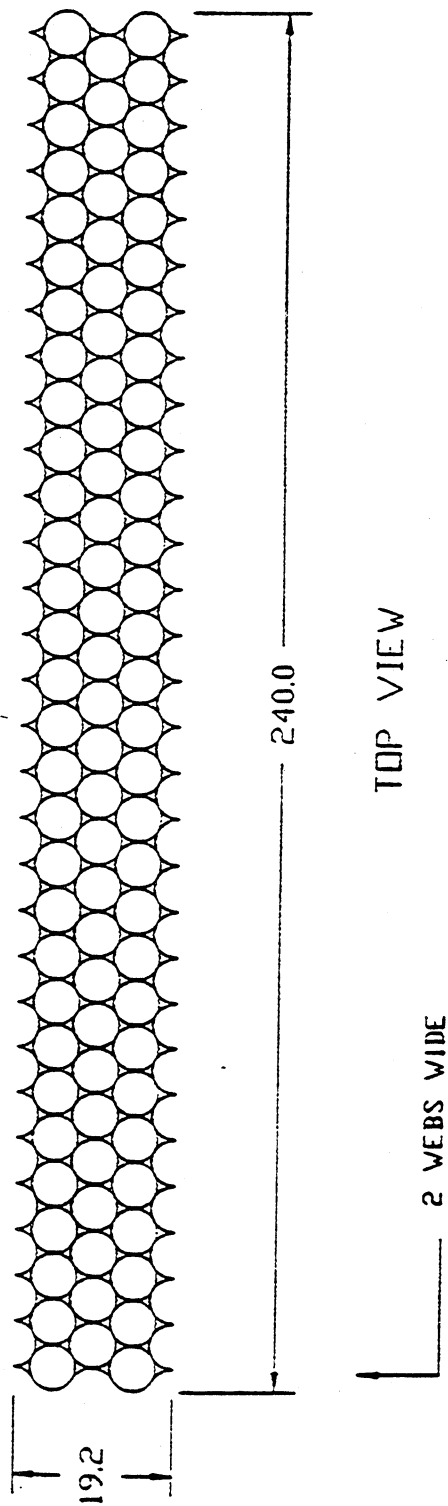
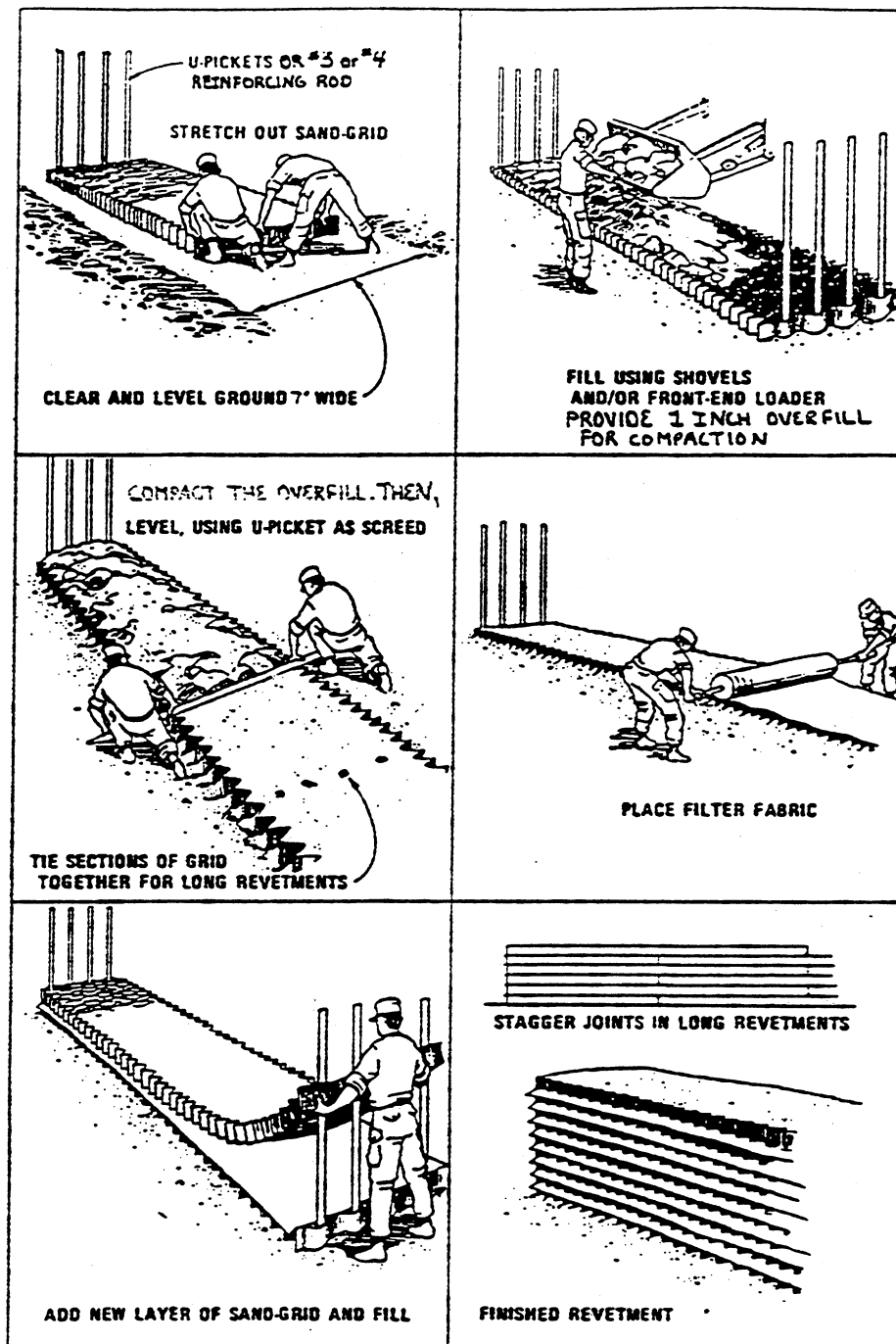


Figure 12



Construction of standard sand-grid revetment.

Figure 13

**TIME/COST ESTIMATION SHEET FOR
GEOWEB® CELLULAR CONFINEMENT SYSTEM INSTALLATION
ON FLAT OR NEAR FLAT SURFACES**

Typical Crew Size and Responsibilities

- 3 People to stretch and pin the GEOWEB sections in place.
- 1 Person to spread and compact the infill material.
- 1 Equipment operator for the front-end loader.

Note: Adding or subtracting one or two people to the crew may result in a cost-effective productivity increase depending on local work habits.

Equipment Needed and Purpose

- Several reusable steel pins or stakes typically of #3 or #4 reinforcing rod to temporarily hold the GEOWEB sections in place before infilling.
- Hog rings and hog ring tool(s) for fastening the GEOWEB sections together.
- A front-end loader for infilling of the GEOWEB sections.
- Rakes and shovels for final leveling of the infill material.
- A vibratory roller compactor or tamper for compaction of the infill material.

Typical Construction Sequences and Times based on an 8' x 20' x 8" GEOWEB section

- 1. Stretch and pin the GEOWEB section in place. 1 minute minimum
- 2. Fill the in place sections using the loader to distribute the infill evenly over the GEOWEB section. 2 minutes minimum
- 3. Level the infill by hand using rakes and shovels so that all cells are filled approximately one inch above top of cell wall. 1 minute minimum
- 4. Compact the infill using the selected compaction equipment. . . . 1 minute minimum

Notes: The above 4 sequences can be in progress at the same time on adjoining GEOWEB sections if working space is adequate.

The above rates decrease when GEOWEB sections are installed on slopes.

PRESTO PRODUCTS COMPANY, P.O. BOX 2399, APPLETON, WI 54913-2399
PHONES: 800-548-3424 □ 414-738-1336 □ FAX: 414-738-1418

January 1991

**TIME/COST ESTIMATION SHEET FOR
GEOWEB® CELLULAR CONFINEMENT SYSTEM INSTALLATION
ON FLAT OR NEAR FLAT SURFACES**

Approximate Quantities of Required Infill Material	
Depth of GEOWEB system (inches)	Infill Material Required per 8' x 20' Section of GEOWEB (Cubic yards)
2½	1.8
3	2.0
4	2.5
6	3.5
8	4.5
NOTE: The above quantities are based on the GEOWEB cell depth plus one inch overfill.	

GENERAL NOTES:

1. The front-end loader must be sized so it can distribute the fill material per time/productivity requirements.
2. Based on the above, an installation rate of 12 sections/hour could be obtained using the 8" GEOWEB sections. Experience shows this to be a moderate rate of installation.
3. Installation rates for depths less than 8 inches should be greater than the rate stated in GENERAL NOTE 2. Experience shows that moderates rates of 20 sections/hour for the 6 inch depth and 24 sections/hour for the 4 inch depth GEOWEB can be obtained.
4. Installation rates on slopes will decrease as slope steepness increases.
5. A stretcher frame is recommended if the GEOWEB sections are installed in water or if temperatures are near or below freezing. The local GEOWEB representative can answer any questions on these or other special conditions which may make the use of a stretcher frame cost effective.
6. As is with all construction operations, placement of material stock piles, crew productivity, jobsite conditions, etc. significantly effect overall productivity, therefore, these recommendations may be either too conservative or too liberal.

**TIME/COST ESTIMATION SHEET FOR
GEOWEB® CELLULAR CONFINEMENT SYSTEM INSTALLATION
ON FLAT OR NEAR FLAT SURFACES**

Estimated Time and Materials Required

Area of installation = length x width of site

()ft long x ()ft wide = ()Ft² Area

GEOWEB sections required = Ft² Area ÷ 160 ft²/section (standard section is 8' x 20')

()Ft² Area ÷ 160 ft²/section = ()Sections

Reusable pins needed = 10 per crew (estimate)

()crews x 10 = ()pins

Hog rings needed = 40 per section + 5% for loss

()Sections x 42 = ()hog rings

Time required for installation per crew = GEOWEB sections ÷ 12 sections/hr for 8" depth,
20 sections/hr for 6" depth or 24 sections/hr for 4" depth GEOWEB

()Sections ÷ 12, 20 or 24 sections/hr = ()hours

Man-hours required for installation = hours x men/crew

()hours x ()men/crew = ()man-hours

Infill material quantities = GEOWEB sections x cubic yards/section (see above table)

()Sections x ()cubic yards/section = ()cubic yards

TIME/COST ESTIMATION SHEET FOR GEOWEB® CELLULAR CONFINEMENT SYSTEM INSTALLATION ON FLAT OR NEAR FLAT SURFACES

Estimated Cost of Time and Materials

GEOWEB section cost \$ _____/section x _____ Sections = \$ _____.

Cost of geotextile \$ _____/yd² x _____ Ft² Area + ⁹/₈ = \$ _____.
(if required)

Cost of pins \$ _____ each x _____ (quantity) = \$ _____.

Cost of hog rings \$ _____/100 x _____ (quantity) = \$ _____.

Cost of Infill \$ _____/yd³ x _____ cubic yards = \$ _____.

Cost of Labor \$ _____/man-hour x _____ man-hours = \$ _____.

Cost of Equip. Operator \$ _____/man-hour x _____ man-hours = \$ _____.

Cost of Front-end Loader \$ _____/hours x _____ hours = \$ _____.

Cost of Compactor \$ _____/hours x _____ hours = \$ _____.

APPROXIMATE TOTAL COST \$ _____.

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January 1991

Figure 17



